

# Assembling the Infrared Extragalactic Background Light with CIBER-2: Probing Inter-Halo Light and the Epoch of Reionization.

Completed Technology Project (2015 - 2020)



## Project Introduction

We propose to carry out a program of observations with the Cosmic Infrared Background Experiment (CIBER-2). CIBER-2 is a near-infrared sounding rocket experiment designed to measure spatial fluctuations in the extragalactic background light. CIBER-2 scientifically follows on the detection of fluctuations with the CIBER-1 imaging instrument, and will use measurement techniques developed and successfully demonstrated by CIBER-1. With high-sensitivity, multi-band imaging measurements, CIBER-2 will elucidate the history of interhalo light (IHL) production and carry out a deep search for extragalactic background fluctuations associated with the epoch of reionization (EOR). CIBER-1 has made high-quality detections of large-scale fluctuations over 4 sounding rocket flights. CIBER-1 measured the amplitude and spatial power spectrum of fluctuations, and observed an electromagnetic spectrum that is close to Rayleigh-Jeans, but with a statistically significant turnover at 1.1  $\mu\text{m}$ . The fluctuations cross-correlate with Spitzer images and are significantly bluer than the spectrum of the integrated background derived from galaxy counts. We interpret the CIBER-1 fluctuations as arising from IHL, low-mass stars tidally stripped from their parent galaxies during galaxy mergers. The first generation of stars and their remnants are likely responsible for the reionization of the intergalactic medium, observed to be ionized out to the most distant quasars at a redshift of 6. The total luminosity produced by first stars is uncertain, but a lower limit can be placed assuming a minimal number of photons to produce and sustain reionization. This 'minimal' extragalactic background component associated with reionization is detectable in fluctuations at the design sensitivity of CIBER-2. The CIBER-2 instrument is optimized for sensitivity to surface brightness in a short sounding rocket flight. The instrument consists of a 28 cm wide-field telescope operating in 6 spectral bands between 0.5 and 2.0  $\mu\text{m}$ , cooled to a temperature of 77 K with a liquid nitrogen cryostat. Images are composed using 3 focal plane assemblies operating H2RG detector arrays. The instrument is currently being fabricated with expected delivery during summer 2014, and will be ready for its first flight in 2015. CIBER-2 will extend the CIBER-1 observations from the near-infrared into the optical, where the EOR and IHL components of the extragalactic background can be cleanly distinguished and separated. We will study the history of IHL production by implementing a multi-band cross-correlation analysis, and use this information to carry out a deep search for an EOR component. In subsequent flights we plan joint observations with weak lensing maps, with an optimized set of filter bands to measure spectral cross-correlations, to fully elucidate the history of IHL light production.



Assembling the Infrared Extragalactic Background Light with CIBER-2: Probing Inter-Halo Light and the Epoch of Reionization.

## Table of Contents

Project Introduction	1
Organizational Responsibility	1
Primary U.S. Work Locations and Key Partners	2
Project Management	2
Technology Areas	2
Target Destination	2

## Organizational Responsibility

### Responsible Mission Directorate:

Science Mission Directorate (SMD)

### Responsible Program:

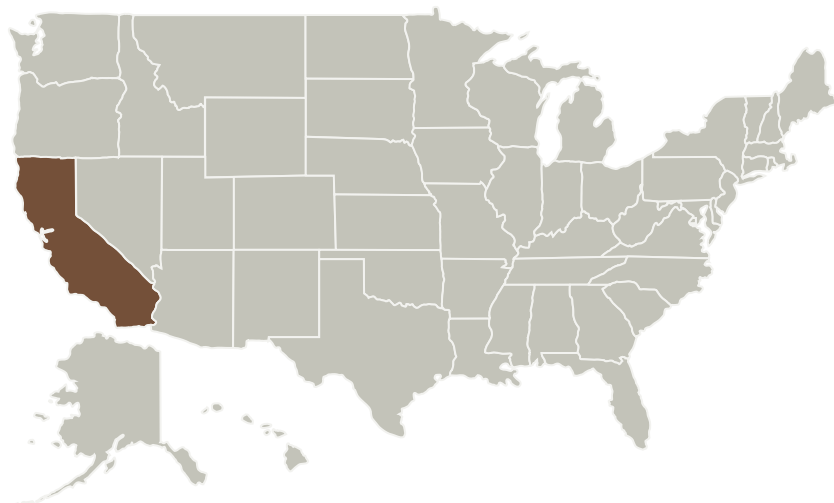
Astrophysics Research and Analysis

# Assembling the Infrared Extragalactic Background Light with CIBER-2: Probing Inter-Halo Light and the Epoch of Reionization.

Completed Technology Project (2015 - 2020)



## Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
California Institute of Technology(CalTech)	Supporting Organization	Academia	Pasadena, California
University of California-Irvine	Supporting Organization	Academia Asian American Native American Pacific Islander (AANAPISI), Hispanic Serving Institutions (HSI)	Irvine, California

### Primary U.S. Work Locations

California

## Project Management

**Program Director:**

Michael A Garcia

**Program Manager:**

Dominic J Benford

**Principal Investigator:**

James J Bock

**Co-Investigators:**

Asantha Cooray

Lucy A Viramontes

## Technology Areas

**Primary:**

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.1 Detectors and Focal Planes

## Target Destination

Outside the Solar System